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SCIENCE

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THE INHERITANCE OF ACQUIRED CHARACTERISTICS.*

PROFESSOR COPE's defense of the doctrine of the inheritance of acquired characters was selected from the evidence contained in his book, 'The Primary Factors of Organic Evolution.' He referred especially to the history of the moulding of the articulations of the vertebrate, and especially of the mammalian skeleton, of which such complete series has been furnished by paleontology. The forms of the articulations he believed to be the result of their movements, for the reason that they could be formed artificially, as the result of experiment, or in consequence of luxations. He believed that the resulting forms have been inherited, because they are found in the embryo before the animal has had an opportunity of developing the structure for himself by interaction with the environment.

He admitted the justice of Dr. Minot's demand for an explanation of this phenomenon. He stated that the preformationists offered no explanation, and, indeed so far as he could see, none was possible from their point of view. The epigenesisists could, on the contrary, appeal to the

* Abstract of Professor Cope's part in the discussion by Professors Minot, Macfarlane, Cope and James before the Boston meeting of the American Society of Naturalists, prepared at the request of the editor by the late Professor Cope.

phenomena of memory as a plausible explanation. Stimuli from without and from within the organism leave a record on the brain-cells which give the form to consciousness, when the latter invades them, along the guiding lines of associations. Why should not the germ-plasma be capable of a similar record of stimuli which is expressed in the recapitulatory growth of the embryo? He thought that the evidence pointed to such a process. These stimuli affected the soma and the germ-plasma simultaneously in accordance with the doctrine of Diplogenesis, but that the soma only records results in each tissue which are appropriate to the functions of the same, while the germ-plasma and brain-cells may record them all. The certainty of record in both cases he supposed to depend on the frequency and strength of the impression, as is known to be the case with the memory of the mental organism. Hence mutilations or single impressions are rarely recorded, while those due to the constant and habitual movements are recorded, and form the physical basis of growth and of evolution of type.

He further remarked that the belief that natural selection originates structure cannot be entertained, as paleontological evidence shows that evolution has proceeded by very gradual additions and subtractions of character, which required long periods to become of any value in the struggle for existence, sometimes an entire geological period being occupied in the elaboration of a character to structural usefulness.

Finally he referred to the physical mechanism of mental phenomena, and stated that some physiologists require a completed machine for the performance of special mental functions. The speaker called attention to the fact that the fundamental sensations do not even require a nervous system for their expression. Thus Protozoa appear to experience the sensa-

tions of hunger, temperature and the muscular sense of resistance. Hence it is as true of the physical basis of mental as of other functions that the function produces the structure, while structure merely specializes or perfects function.

ORGANIC SELECTION.

IN certain recent publications* an hypothesis has been presented which seems in some degree to mediate between the two rival theories of heredity. The point of view taken in these publications is briefly this: Assuming the operation of natural selection as currently held, and assuming also that individual organisms through adaptation acquire modifications or new characters, then the latter will exercise a directive influence on the former quite independently of any direct inheritance of acquired characters. For organisms which survive through adaptive modification will hand on to the next generation any 'coincident variations' (*i. e.*, congenital variations in the same direction as adaptive modifications) which they may chance to have, and also allow farther variations in the same direction. In any given series of generations, the individuals of which survive through their susceptibility to modifi-

* H. F. Osborn, Proc. N. Y. Acad. of Sci., meeting of March 9 and April 13, 1896, reported in *SCIENCE*, April 3 and November 27, 1896. C. Lloyd Morgan, 'Habit and Instinct,' October, 1896, pp. 307 ff., also printed earlier in *SCIENCE*, November 20, 1896. J. Mark Baldwin, discussion before N. Y. Acad. of Sci., meeting of January 31, reported in full in *SCIENCE*, March 20, 1896, also *Amer. Naturalist*, June and July, 1896. The following brief statement has been prepared in consultation with Principal Morgan and Professor Osborn. I may express indebtedness to both of them for certain suggestions which they allow me to use and which I incorporate verbally in the text. Among them is the suggestion that 'Organic Selection' should be the title of this paper. While feeling that this cooperation gives greater weight to the communication, at the same time I am alone responsible for the publication of it.